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SYNONYMISED AND FORGOTTEN, THE BIRD'S HEAD STOUT-TAILED SNAKES, *CALAMOPHIS* MEYER (SQUAMATA: SERPENTES: HOMALOPSIDAE)

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ABSTRACT. — *Calamophis jobiensis* Meyer disappeared into the synonymy of *Brachyorrhos albus* in1893. Although the holotype of *jobiensis* was destroyed in World War II, six museum specimens similar to *jobiensis* were subsequently found in three museum collections. Morphological analysis suggests that *Calamophis* is a valid genus distinct from *Brachyorrhos* and the six museum specimens, none of which are conspecific with *jobiensis*, represent three undescribed species. *Calamophis* appears to be endemic to Yapen Island in the Bird's Head region of West Papua, Indonesia. Based upon their body form, two of the species with cylindrical bodies and stout tails appear to be cryptozoic/fossorial/ aquatic species. The third species has a remarkable lateral compression of the body, an exceptionally abbreviated tail and narrow ventrals that suggest it is an aquatic form, possibly evolved from a fossorial ancestor.

KEY WORDS. — systematics, *Brachyorrhos*, new species, Bird's Head Region, West Papua, New Guinea

INTRODUCTION

Snakes of the family Homalopsidae are widely distributed in Southeast Asia and Australasia and exhibit a spectrum of lifestyles from completely terrestrial to completely aquatic. Gyi (1970) recognised 10 genera and 36 species of homalopsids, Murphy (2007) listed 37 species in 10 genera and provisionally listed two other genera (*Brachyorrhos* and *Anoplohydrus*) as incertae sedis. Recently, *Brachyorrhos* has been confirmed as the most basal genus of the family (Murphy et al., 2011, 2012) and another two genera and two new species were recently added (Murphy, 2011), raising the family's composition to14 genera and 41 species.

The addition of *Brachyorrhos* to the Homalopsidae prompted a review of the genus (Murphy et al., 2012) and revealed diversity lost in synonymy. Meyer (1874) described *Calamophis jobiensis* from a single specimen collected on Yapen Island in Cenderawasih Bay, situated in the northern part of the Indonesian Province Papua. Peters and Doria (1878) assigned *Calamophis jobiensis* Meyer to *Brachyorrhos* Kuhl because they did not consider the character traits that distinguished *Brachyorrhos* and *Calamophis* to warrant generic status (a single internasal and a short, rounded snout). In addition, they thought the single internasal was inconsistent, because they included a specimen said to be from the Aru Islands in their analysis. Boulenger (1893) considered *Brachyorrhos jobiensis* a junior synonym of *Brachyorrhos albus* (Linnaeus) apparently without actually examining any specimens; all of the specimens discussed and listed in his catalogue account are from the Moluccan Islands, but *C. jobiensis* is from Yapen Island (north coast of western Papua) and yet *Calamophis jobiensis* Meyer is in his synonymy. Yapen Island is more than 640 km from the eastern edge of Seram (Southern Moluccas), and more than 820 km from the southern tip of Halmahera (Northern Moluccas), the two closest known localities where *Brachyorrhos* is likely to occur. Authors of regional reptile checklists (Rooij, 1917; Kopstein, 1926; de Haas, 1950; Welch, 1988) followed Boulenger's arrangement for *Brachyorrhos albus.* Barbour (1912) conjectured that *Calamophis jobiensis* Meyer was a valid taxon of *Brachyorrhos*, but had not examined any material. Iskandar and Colijn (2001) listed *Brachyorrhos jobiensis* as a valid species based upon a personal communication from Van Wallach.

The holotype of *Calamophis jobiensis* Meyer was destroyed during the Allied bombing of Dresden during World War II (fide Iskandar & Colijn, 2001). Murphy (2007) examined BMNH 1910.4.26.60 and BMNH 1998.330 from Seram, both specimens catalogued as *Brachyorrhos jobiensi*. McDowell (1987) examined BMNH 1910.4.26.60 and wrote "…I suspect this specimen is a Ceram record for *Brachyorrhos jobiensis*." Murphy (2007) found relatively few differences between the Seram specimen BMNH 1998.330 and *B. albus* from Ambon and Seram. BMNH 1910.4.26.60 however has a distinct preocular, a loreal, a greatly reduced ventral count, and a small adult body size. Its overall morphology suggests it is a dwarf *Brachyorrhos* and it will be described elsewhere.

During a review of *Brachyorrhos*, six specimens similar to *Calamophis jobiensis* Meyer were found. Murphy et al. (2012) removed *Calamophis* Meyer from *Brachyorrhos* based upon a suite of morphological differences. Here the six specimens of *Calamophis* are discussed.

MATERIAL AND METHODS

Museum material related to *Brachyorrhos* and *Calamophis* was examined. External morphological nomenclature follows Peters (1964) and Lillywhite (2008). Measurements of body and tail lengths were taken to the nearest 1 mm. Photographs were taken with a Spot Digital Xplorer™ camera and a Leica Microscope. Method of counting ventrals follows Dowling (1951); the terminal scute was not included in the number of subcaudals. The dorsal scale row counts were made at about 10 ventrals behind the head, at mid body, and about 10 ventrals anterior to the vent. Values for paired head scales and subcaudals are given in left/right order. Abbreviations used are: *ASL* – above sea level; *MYA* – millions of years ago, *PCA* – principal component analysis; *PLP* – preocular-loreal-prefrontal shield; *SVL* – snout vent length; *T* – tail length.

RESULTS

Fifty-five specimens of *Brachyorrhos*, including six specimens considered to be *B. jobiensis* (Meyer) were coded for 25 morphological and morphometric traits (Table 1) and analysed with a PCA; the results are shown in Murphy et al. (2012) and confirm what is illustrated in Figs. 1 and 2, *Calamophis* is morphologically distinct from *Brachyorrhos*. Peters and Doria (1878) were correct, *Calamophis* has a short, rounded snout and a single internasal; but they were mistaken about the internasal being divided in one specimen. The specimen thought to be from the Aru Islands was in fact a *Brachyorrhos* (MSNG 56342) that is superficially similar in pattern and colouration to two of the *Calamophis* specimens (MSNG 56343-2). At least eight other morphological traits distinguish *Calamophis* as separate from *Brachyorrhos*; these are listed in Table 1.

Homalopsid snakes share a crescent-shaped nare, valvular nostrils, a lack of apical pits on scales, a conservative braincase, frontals that are low and have trabecular ridges, and a strong back-turned maxillary process (Underwood, 1967; Gyi, 1970; Murphy, 2007). Homalopsids also have hypapophyses throughout the vertebral column, grooved rear-fangs, and are viviparous. However, although *Brachyorrhos* is viviparous, it lacks fangs and has not been examined for the other skeletal traits. *Calamophis* also lacks rear fangs, and its mode of reproduction is unknown. But, based on a single skull (from BPBM 3850), it does have a conservative braincase and the low frontals reported in homalopsids by Underwood (1967), but the frontals lack the trabecular ridges found in the aquatic genera (Underwood, 1967). Instead, a strut-like, pre-orbital process contacts the frontals, apparently to provide extra support; an arrangement that would be expected in a burrowing snake. The single skull examined shares the strongly back-turned maxillary process found in other homalopsids (Underwood, 1967; Gyi, 1970). These traits and the 15 shared external morphological traits (in Table 1) suggest that *Calamophis* is indeed a member of the Homalopsidae.

The two genera are also geographically separate, with *Brachyorrhos* restricted to the Moluccan Islands and *Calamophis* known only from the Bird's Head Region of West Papua and Yapen Island.

Table 1 also summarises 15 shared morphological traits that suggest a close relationship between the two genera. Given that *Brachyorrhos* species are the most basal homalopsids (Murphy et al., 2011) and they share numerous traits with *Calamophis*. Thus, tentatively including *Calamophis* in the Homalopsidae, pending confirmation from molecular data is warranted.

Calamophis Meyer

Calamophis Meyer, 1874: 135
Brachyorrhos: Peters & Doria, 1878: 371
Brachyorrhos: Boulenger, 1893: 305

Type species. — *Calamophis jobiensis* Meyer, 1874, by monotypy.

Diagnosis. — *Calamophis* is distinguished from *Brachyorrhos* by the following morphological traits: rostral broader than tall (as tall as broad in *Brachyorrhos*), nasal scale undivided (divided and bilobed in *Brachyorrhos*); internasal single (divided in *Brachyorrhos*); postocular single (two in *Brachyorrhos*); dorsal scales imbricate in 19 rows that are reduced to 17 anterior to the vent (not reduced in *Brachyorrhos*); base of tail slightly constricted in two of these species; tail is thick and tapers slowly to an almost blunt tip (stout); males have tubercles on scales in the first 4 rows just anterior and posterior to the vent. Dorsal scales in the vertebral row dorsal to the vent tend to be enlarged from the fusion of dorsal scales, these may number three to seven scales. *Brachyorrhos* may have fused scales on the dorsal surface of the tail, but are absent immediately over the vent.

Distribution. — *Calamophis* appears to be restricted to Yapen Island and the Bird's Head Region of West Papua. It is known from: Andai (a coastal wetland about 35 m ASL); the Arfak (Mt. Arfak) Mountains, elevation unknown, but the range has peaks that exceed 2500 m; and the Tamrau Mountains (Kebar Valley at about 550 m ASL and Ambuaki ~800 m ASL). Both the Arfak and Tamrau Mountains are part of the Vogelkop Highlands, an area of rugged topography and a biodiversity hot spot. Yapen Island is about 250 km from Andai, and none of the Bird's Head localities are more than 100 km apart (Fig. 4). The Papua New Guinea locality for *B. jobiensis* in Iskandar and Colijn (2001) is based on *Mainophis robusta*, which is a synonym of the elapid *Furina tristis* (Shea & Sadlier, 1999) and should not be included in synonymies of *Calamophis* or *Brachyorrhos*.

Table 1. A comparison of the two genera *Brachyorrhos* Kuhl and *Calamophis* Meyer. Data is a composite for at least four distinct species in each genus.

Characters	*Brachyorrhos*	*Calamophis*
N=	52	6
maximum SVL	660 mm	320 mm
TL/SVL	8.9–18.5	3.7–12.3
ventrals	143–182	143–161
subcaudals	18–42	8–23
subcaudals	divided	divided
anal plate	divided	divided
mid body scale rows	19	19
post body scale rows	19	17
scale shape	ovate	lanceolate
scale positioning	juxtaposed	imbricate
postocular	two	one
preocular	0 or 1	one
upper labials	5–7	5–6
upper labials at PLP	2–3	2–3
upper labials in orbit	3, 3+4, 4	3, 3+4, 4
tallest upper Labial	3, 5, 6	4, 5, or 6
no. lower labials	7 (6,8)	7 (?8)
internasal	divided	single
loreal	usually fused	fused
primary temporals	1 or 2	1 (2)
mid ventral stripe	in one species	in all species
fused dorsal scales over vent	usually none	present
tail shape	tapered	stout
tubercles in males near vent	weak but present	present
dorsal patterns adults	uniform	uniform or striped

Etymology. — It is unclear if Meyer named this snake using the Latin root *calamitas* (calamity, misfortune, disaster) or *calamus* (anything made of a reed, such as a pen or arrow). The latter seems more probable given the striped pattern of the type species.

Content. — 4 species

Calamophis jobiensis Meyer, 1874

Calamophis jobiensis Meyer, 1874: 135
Holotype. — MTKD (Museum für Tierkunde Dresden) 1026, destroyed in World War II
Type Locality. — Ansus, Yapen, Indonesia (about 1°43'2"S, 136°7'57"E)

Brachyorrhos jobiensis: Peters & Doria, 1878: 371
Brachyorrhos albus: Boulenger, 1893: 305

Comment. — The now lost holotype reportedly had 164 ventrals and 10 subcaudals (Meyer, 1874) and presents the need to recover additional specimens from the type locality. Meyer's original description (see below) has some problems. He noted a hexagonal frontal that contacts the upper labials—the frontal cannot contact the upper labials. The PLP shield does contact the upper labials in these snakes, but it is not hexagonal, and he noted that the temporals are "placed irregularly." This may mean the secondary temporals are indistinguishable from other scales, which is the case in *Calamophis*. His description does not match any of the specimens examined here particularly well, although the ventral counts, subcaudal counts, and pattern are most similar to the next species discussed. Given that the three new species described here all occur within 100 km of each other and the type locality is on Yapen Island 250 km away, it seems unlikely that *B. jobiensis* will be found on the New Guinea mainland.

Distribution. — Known only from the type locality of Ansus, Yapen Island, located on the southwestern coast of the island. The *B. albus* specimen reported from Aru by Doria (1874) and Peters and Doria (1878) is considered by Iskandar and Colijn (2001) to be *B. jobiensis*, probably because the Aru Island fauna is considered West Papuan. However there is no evidence that *Calamophis* occurs in the Aru Islands. The single specimen allegedly from Aru (MSNG 56342) examined for this study clearly belongs to the genus *Brachyorrhos* and the specimen is discussed in Murphy et al. (2012).

Diagnosis. — The diagnosis is based upon a translation of the original description (see below). A *Calamophis* with 164 ventrals and 10 subcaudals. Table 2 compares the four species.

Supralabials six, third and fourth enter the orbit; eight lower labials; one preocular; one postocular. The pentagonal internasal contacts the rostral with one side and enters with a point in between the prefrontals. These broader than long, hexagonal. Frontal hexagonal, longer than wide, and the sides reaching the upper labials. Temporals placed irregularly. Body scales in 19 longitudinal rows, smooth. Subcaudals in two rows of 10; 164 ventrals.

Dorsum brown, with as many whitish, narrow longitudinal stripes extending along the entire length of the body as there are longitudinal scale rows. At each side of the likewise brown ventrals is a wide, bright yellowish-white stripe, which meets at the throat and ends as a wide side band. On the back of the head two slightly lighter brown spots, muzzle and labials light brown as well.

***Etymology*.** — The island of Yapen has also been called Japen and Jobi. Therefore, *C. jobiensis* is likely named after the Indonesian island.

***Calamophis katesandersae*, new species**

(Fig. 3a)

Brachyorrhos jobiensis: Peters & Doria, 1878: 371
Brachyorrhos albus: Boulenger, 1893: 305

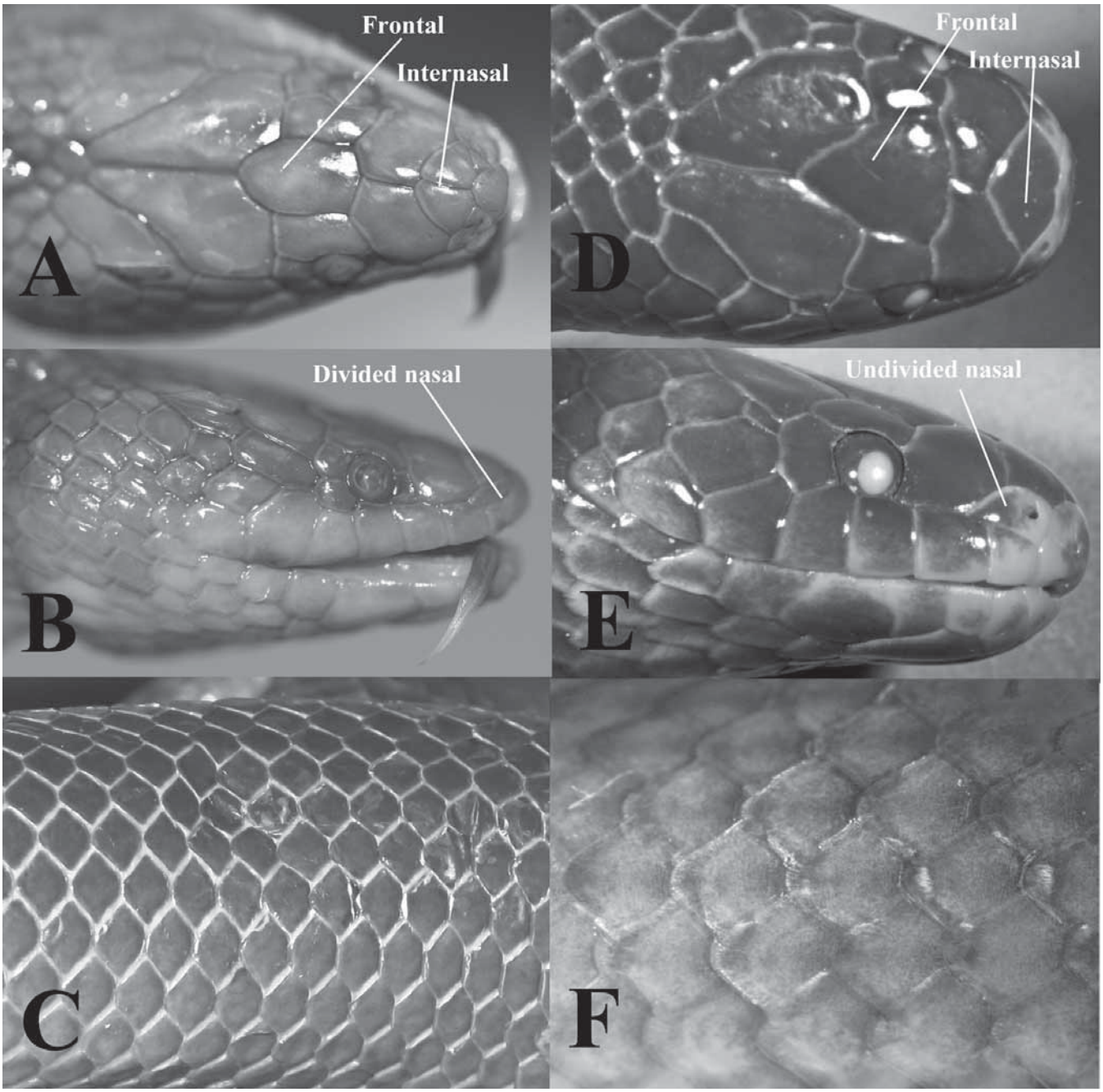

Fig. 1. A comparison of *Brachyorrhos* A–C, FMNH 142323 (left) and *Calamophis* D–F, MSNG 3193-1(right). *Brachyorrhos* have a pentagonal/hexagonal frontal, divided internasal, and a narrow, long snout (A), a divided nasal that is bilobed, and two postoculars (B), and dorsal scales that are more juxtaposed than imbricate (C). *Calamophis* have a pentagonal/triangular frontal, a single internasal, and a broad, relatively short snout (D), an undivided nasal and a single postocular (F), and scales that are imbricate.

Table 2. A comparison of the four species of *Calamophis.* The data for *jobiensis* is from the original description (Meyer, 1874). nd = no data.

Characters	*jobiensis*	*katesandersae*	*ruuddelangi*	*sharonbrooksae*
N=	0	2	2	2
distribution	Yapen Island	Andai	Kebar Valley & Ambuaki	Mt. Arfak
upper labials	6	5 or 6	6	6
tallest upper labial		5	4	4
lower labials	8	7	7	7
ventral count	164	157–160	143–145	149–150
subcaudals	10	8–9	21–23	17–19
T/SVL (%)	nd	3.7–3.8	12.3–12.5	9.0–9.6
compressed body	nd	yes	no	no
center spot in dorsal scales	yes	yes	yes	no
ventro-lateral stripe	yes	yes	yes	no
brown spots on head	yes	no	no	no

Material examined. — *Holotype* – MSNG 56343-1, presumably an adult female 223 mm in total length, collected by A. A. Bruijn in Dec.1875 at Andai, West Papua, Indonesia (~0°54'58"S, 134°00'25"E). *Paratype* – MSNG 56343-2, a smaller, subadult female, 163 mm in total length collected at the same time and at locality as the holotype.

Diagnosis. — A *Calamophis* with a laterally compressed body (mid body width is 75–79% of the body's height) and an exceptionally short tail (3.7–3.8% of the SVL). This species may be distinguished from the other three species by its compressed body; a frontal that is pentagonal but almost triangular; five or six upper labials; seven lower labials; a low subcaudal count (eight or nine), and an exceptionally short tail. The rostral to frontal distance is less than the length of the parietal seam. Based on its original description *C. jobiensis* may be most similar to this species. However it has a hexagonal frontal, eight lower labials, and a colour pattern of narrow white stripes running the length of the body (the pattern of this species could be interpreted to be similar to *jobiensis*). This species lacks the constriction at the base of the tail, present in the other two species. See Fig. 2.

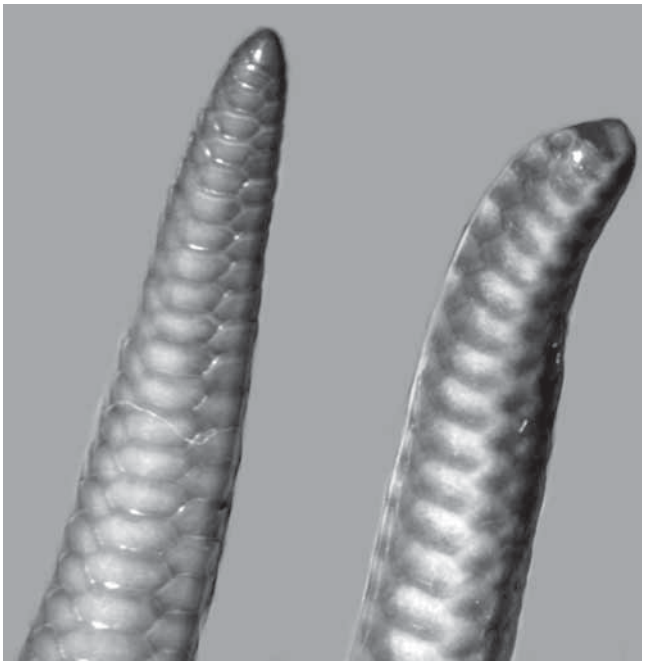

Fig. 2. Comparison of the tapering tail of *Brachyorrhos* (MSNG 30211) on left and the stout tail of *Calamophis* (BPBM 3850) on right.

Description of holotype. — Presumably an adult female, SVL 215 mm, 8 mm tail, T/SVL=3.7%. Tail is short, thick and ends with a small conical, somewhat blunt tip. The body is strongly compressed laterally; its width is about 75% of its height at mid body. Rostral broader than tall, slightly visible from above, separates the nasals; nasal scales are undivided, quadrangular, not lobed, very small nostril centered in the scale, posterior edge penetrates the loreal-labial seam; PLP shield contacts a upper labials 2–3 and the orbit; frontal triangular, longer than broad, about equal in length to the parietal seam; six upper labials, 3+4 enter the orbit; the fifth labial is the tallest. Eye diameter less than the eye-mouth distance, orbit bordered by one supraocular, one postocular, two upper labials and the PLP shield. Primary temporal scale is larger than the nearby dorsal scales and contacts large occipital scale on left, not on right; secondary temporals are not differentiated. Lower labials seven; the first pair of lower labials make contact on the midline of the chin posterior to the mental; first four contact the chin shields. Dorsal scales are smooth, in 19 rows on the anterior body, at mid body, followed by a posterior reduction to 17 rows in front of the vent. Ventrals 160, rounded and reduced in width; subcaudals paired, 9/8.

In alcohol, each dorsal scale has a brown center and a light edge making each scale appear as a small dot surrounded by cream. The first scale row has a smaller central brown spot and combined with a light edge on the outer venter forms a ventrolateral stripe. Each ventral scale has a broad central dark blotch. There are light cream patches on the rostral and nasals, on the edges of the labial scales, and on the parietals and adjacent dorsal scales immediately behind the head. The light coloured transverse parietal band forms a distinctive mark on the crown. The chin is mostly cream

with dark brown blotched on the chin shields and the second row of gulars.

***Paratype*.** — Possibly a subadult female, 157 mm SVL, 6 mm tail, tail/SVL =3.8%; 157 ventrals; 8/9 subcaudals. It is very similar to the holotype in colouration and scale counts with one exception, it has five upper labials on each side, the second contacts the PLP shield and enters the orbit on the right side, on the left side the second labial does not enter the orbit, the third does, and it also contacts the PLP shield with the second upper labial.

***Etymology*.** — Named in honour of Kate Laura Sanders for her work on the evolution of sea snakes and interests in snake phylogeny.

Calamophis ruuddelangi, new species
(Fig. 3b)

Brachyorrhos jobiensis: Peters & Doria, 1878: 371
Calamophis jobiensis: Sauvage, 1878: 60
Brachyorrhos albus: Boulenger, 1893: 305

***Material examined*.** — *Holotype*. – MNHN 5175. A 261 mm (total length) male. Collected by Achille Raffray, about 1877, at Ambuaki in the Tamrau Mountains (~ 0°46'S, 132°57'E) West Papua. This species is based on two, presumably adult specimens, collected at two localities about 96 years apart.

***Paratype*.** — BPBM 3850. A 246 mm (total length) male; collected in West Papua, Manokwari Division, Kebar Valley, about 550 m by L. & S. Quate in Jan.1962 (appears to be a road kill).

***Diagnosis*.** — A gracile *Calamophis* with a cylindrical body and relatively short tail (12% of SVL); six upper labials, fifth tallest, three and four are distinctly shorter, 143–145 ventrals, 21–23 subcaudals. *B. jobiensis* has more ventrals (164) and fewer subcaudals (10), hexagonal frontal, and a dorsal pattern of fine white lines that run the length of the body. The rostral to frontal distance is less than the length of the parietal seam. The species lacks the distinct ventro-lateral stripe found in *C. katesandersae* and has a longer tail. Note: Sauvage (1878) discusses this specimen (MNHN 5175) as *C. jobiensis* and reports it having 15 dorsal scale rows, 142 ventrals and 21 subcaudals. Only his subcaudal counts agree with the data collected for this study.

***Description of holotype*.** — A 232 mm SVL male with a 29 mm tail; tail/SVL = 12.5%. Body cylindrical with slight constriction at base of tail. The rostral is barely visible from above and separates the single, undivided nasals; nares are visible from above, centered in the scale; the internasal is small, and shorter than the supraocular; prefrontal, loreal, and preocular are fused to form a PLP shield that makes contact with upper labials and the orbit; upper labials six; upper labials 2–3 make contact with the PLP shield, the 3+4 enter the orbit, the fifth is the tallest. The primary temporal scale is larger than the nearby dorsal scales, secondary temporal not differentiated. Lower labials seven; the first pair of lower labials make contact on the midline of the chin posterior to the mental; first four contact the chin shields; two pair of chin shields, the second pair barely distinguishable from the gulars. Dorsal scales on the body are smooth and in 19 rows on the neck and at mid body, posterior reduction to 17 rows in front of the vent; dorsal scales in the first four rows above the vent have tubercles, these extend anteriorly five or six ventrals and posteriorly for 2–3 subcaudals. Ventrals 143, rounded, subcaudals divided, 21/21.

In alcohol: overall appearance is a small, gracile, uniform brown snake from above; each dorsal scale has a dark center and a lighter outer edge. Crown brown, rostral, lower edge of upper labials cream, lower labials cream, scales posterior to jaw cream and narrow into an anterior stripe on the first dorsal row of scales for about the first 10 ventrals; each ventral scale is dark brown with a lighter lateral edge, which forms an indistinct stripe.

***Paratype*.** — BPBM 3850 is 219 mm SVL, 27 mm tail, tail/SVL = 12.3%; ventrals 143, subcaudals 23/23. The skull

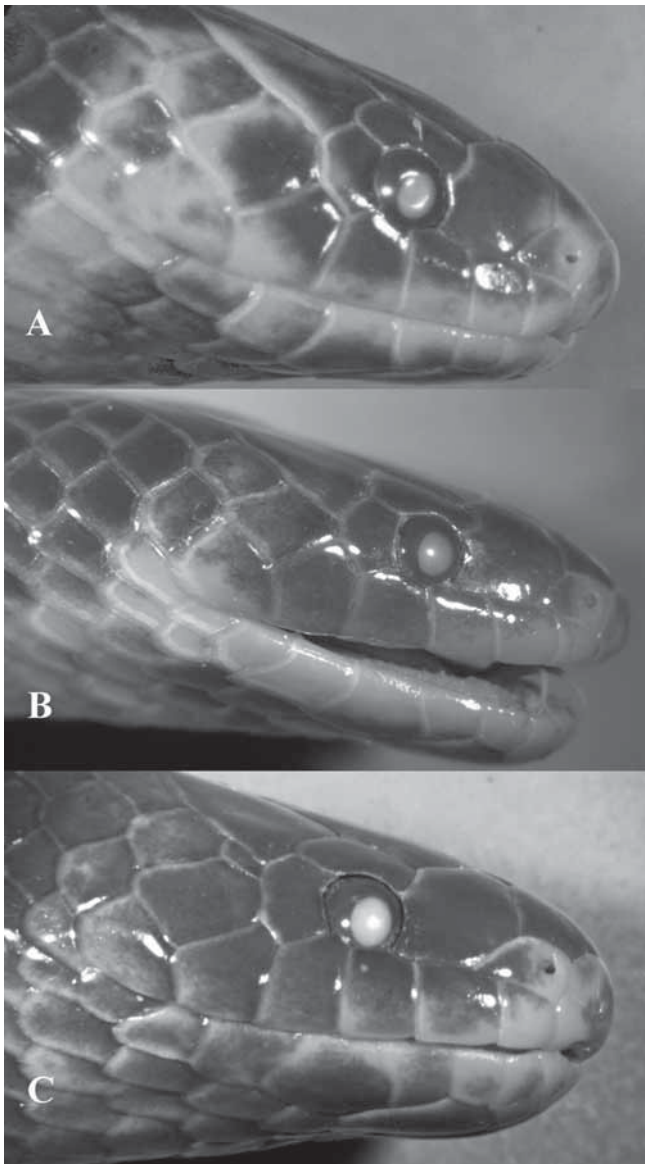

Fig. 3. A comparison of the three new species of *Calamophis*: A, *Calamophis katesandersae*; B, *Calamophis ruuddelangi*; C, *Calamophis sharonbrooksae*.

has been removed and the head scales are slightly distorted, but the scale counts and arrangements are almost identical to the holotype. However, this specimen lacks the second pair of small chin shields present in the holotype. Tubercles are also present on the first two or three scale rows just anterior and posterior to the vent. Colour and pattern same as holotype.

***Etymology*.** — Named in honour of Ruud de Lang for his work on the herpetofauna of Indonesia.

Calamophis sharonbrooksae, new species
(Fig. 4c)

Brachyorrhos jobiensis: Peters & Doria, 1878: 371
Brachyorrhos albus: Boulenger, 1893: 305

Material examined. — *Holotype.* – MSNG30193-1, a 315 mm adult male collected by A. A. Bruijn, 1875 on Mount Arfak, West Papua, Indonesia (~ 1°05'00"S, 133°58'00"E). This species is based upon two specimens collected at the same time and same location.

***Paratype*.** — MSNG30193-2 an adult male, 316 mm in total length, collected at the type locality.

***Diagnosis*.** — A robust *Calamophis* with a cylindrical body, tail 9.0 to 9.6% of the SVL; upper labials three, four and five about equal in height; the rostral to frontal distance is greater than the parietal seam. Dorsal scales are uniform brown—no center spot of dark pigment. All other species have dorsal scales with a dark central spot and a light outer edge. In *C. katesandersae* the fifth upper labial is the tallest; the body is laterally compressed; and the tail is about 4% of the SVL. *C. ruuddelangi* has a cylindrical body; and a tail that is about 12% of the SVL.

***Description of holotype*.** — A 288 mm SVL male with a 26mm tail; tail/SVL = 9.0%. Body cylindrical, slight constriction at base of tail, tail round and somewhat blunt. The rostral not visible from above and separates the single, undivided nasals; nares barely visible from above, centered in the scale; the internasal is small, and about equal to the length of the supraocular; prefrontal, loreal, and preocular are fused to form a PLP shield that makes contact with upper labials and the orbit; upper labials six; upper labials 2–3 make contact with the PLP shield; the 3–4 enter the orbit; 3–4–5 about equal in height; two primary temporal scales, the upper temporal is tiny; secondary temporal indistinguishable from nearby dorsal scales. Lower labials seven; the first pair make contact on the midline of the chin posterior to the mental, first four contact the only pair chin shields. Dorsal scales on the body are smooth and in 19 rows on the neck and at mid body, posterior reduction to 17 rows in front of the vent; dorsal scales immediately over vent fused and plate-like; dorsal scales in the first 4–5 rows above the vent have tubercles, these extend anteriorly five or six ventrals and posteriorly for 2–5 subcaudals. Ventrals 150, rounded, subcaudals divided, 19/19. In alcohol: overall appearance is a small, robust, uniform dark brown, almost black, snake from above; each dorsal scale is uniform brown (no center spot), but the anterior edge of each scale is slightly darker than the rest of the scale; crown same dark brown as dorsum, rostral, lower edge of upper labials cream, lower labials cream on outer edges only; each ventral scale is dark brown with a lighter lateral edge, which forms an indistinct ventrolateral stripe; the ventral side of the tail is slightly darker in colour than the venter of the body.

***Paratype*.** — MSNG 30193-2 is also a male, 290 mm SVL, 28 mm tail, T/SVL = 9.6%. Its head is damaged on the right side. Ventrals 149; subcaudals 17. It is otherwise like the holotype with the exception of the temporal, it has only one primary temporal on each side; and it has smaller fused dorsal scales over the vent.

***Etymology*.** — Named in honour of Sharon E. Brooks, for her work on the homalopsid snakes of Tonle Sap, Cambodia.

DISCUSSION

The resurrection of *Calamophis* Meyer by Murphy et al. (2012) is a reminder that the synonymies performed by Boulenger, and others, in the mid and late 19th centuries masked much of the diversity of the herpetofauna and mislead early 20th century herpetologists into a paradigm that the fauna was less diverse than it actually is.

Fused head plates, low dorsal row counts, wide ventrals and short tails are usually associated with burrowing life styles in snakes, while dorsally positioned nostrils, reduced ventrals, and lateral compression of the body are associated with aquatic life styles (Greene, 1997). The ancestral *Calamophis* has diverged into at least three ecomorphs.

The three distinct body shapes (Table 3) found within these species is of interest. Two of the *Calamophis* (*C. ruuddelangi* and *C. sharonbrooksae*) described here have relatively short tails (8–12% of the SVL) and cylindrical bodies, but one is gracile (*C. ruuddelangi*) and the other robust (*C. sharonbrooksae*). The third species (*C. katesandersae*) has a strongly laterally compressed body, narrow ventrals (Fig. 7),

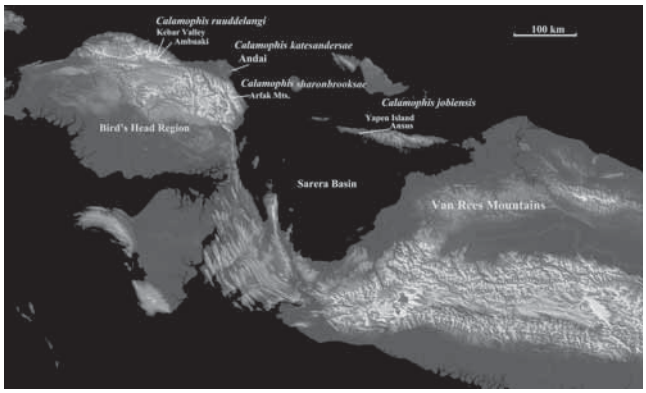

Fig. 4. A satellite image of West Papua, showing the geographic areas and the localities discussed in the article. Satellite image from OC® Product courtesy of TTI Production, 136 Rue Guy Arnaud, 30900 Nîmes, France.

Table 3. Comparison of the body shapes for three species of *Calamophis*. 'Width' refers to the width of the body (in mm) at mid-body; 'height' refers to the height of the body (in mm) at mid body.

Species	Museum #	width (mm)	height (mm)	w/h
ruuddelangi	BPBM 3850	7	7	1.0
	MNHN 5175	6	6	1.0
sharonbrooksae	MSNG 30193(1)	8.4	8	1.05
	MSNG 30193(2)	8.8	8.2	1.07
katesandersae	MSNG 56343(1)	6.4	8.3	0.77
	MSNG 56343(2)	4.2	5.3	0.79

and an exceptionally short tail (3.8% SVL). None of them have dorsally placed eyes, although *C. katesandersae* has eyes that are slightly more dorsolateral than the other two, and all have nostrils that are more anterior, than dorsal or lateral. Given these three ecomorphs, the natural history of these snakes promises to be of interest. While all of these species are in need of phlyogenetic analysis to determine their position in the family, *C. katesandersae* is of particular inertest given its derived body form.

Faunal connections between the Moluccas and New Guinea, particularly the Bird's Head region are numerous. Aplin (1998) examined the zoogeography of the Bird's Head vertebrae fauna and found most vertebrate groups show significant endemism, particularly among aquatic and montane taxa. The mammal fauna of Halmahera and Obi is composed entirely of endemic species and species with affinities to New Guinea (Flannery, 1995). Derived monitor lizards of a clade within the *Varanus indicus* group inhabit the Moluccan Islands, while less derived species (*Varanus prasinus* group) are restricted to New Guinea and islands of the Sahul Shelf. This suggests that the large-scaled *indicus* group have moved west from New Guinea, possibly by vicariance (Weijola, 2010).

The Bird's Head is a complex composite of terranes accreted to New Guinea during the Neogene (including the Arfak and Tamrau terranes), collectively these terranes are known as the Vogelkop Highlands, a biodiversity hot spot (Beehler, 2007). Murphy et al. (2011) suggested that the *Brachyorrhos* lineage arose in the early Miocene to late Oligocene; a period of time (30–20 MYA) that Hall (2001) describes as the most important Cenozoic plate boundary reorganisation within Southeast Asia. About 25 MYA the New Guinea passive margin collided with the leading edge of the east Philippines-Halmahera-New Guinea arc system. About 7–5 MYA (Middle/Late Miocene-earliest Pliocene) Yapen Island was directly abutted against northeastern Irian Jaya on the east side of the Sarera Basin, thus faunal similarities should be expected, given Yapen is a fault sliver rifted from the Van Rees Mountains (~2°34'60"S, 138°15'00"E) (Charlton, 1997; Polhemus et al., 2004). While *Calamophis* is unknown from this region, its presence on Yapen suggests it may be present on both sides of the Sarera Basin.

The morphological similarities between *Brachyorrhos* and *Calamophis* suggest relatedness and together, they likely form a clade of eastern Indonesian homalopsids. The addition of *Calamophis* to the Homalopsidae expands the morphological and ecological diversity of the family and one that can provide insight into the evolution of rear-fangs, diet, and terrestrial-aquatic transitions in advanced snakes. However, confirmation of this placement awaits molecular analysis. The number of homalopsid genera and species is now at 15 genera and 45 species, and likely to increase as more taxa with uncertain relationships are examined and the herpetofauna of poorly known regions are explored in more detail.

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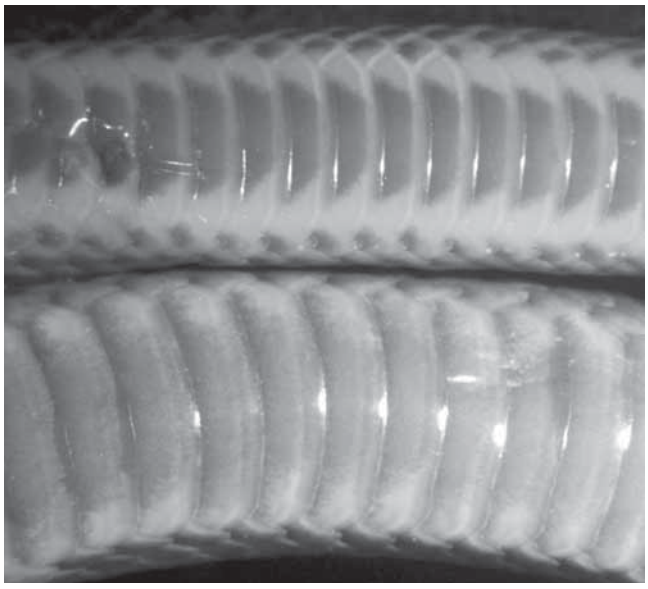

Fig. 5. A comparison of the ventrals and body widths of *Calamophis katesandersae (*MSNG 56343-1) and *Calamophis sharonbrooksae* (MSNG 30193-1).

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